(3)

PEOPLE MOVER CARSHELLS

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- european: B29C65/54; B29C65/72; B29C70/08D; B29C70/44A; B29C70/54E2; B32B7/04; B62D27/02C; B62D29/04C
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Cited documents:
US4663920 (A)
US4949536 (A)
US4712623 (A)

Abstract of **WO 0009362 (A1)**

People mover carshells (10), which include a plurality of body panels which are secured to each other through an adhesive. Mechanical fasterners may also be used to prevent peeling of the body panels. The panels are formed from a composite that includes an instumescent fabric layer resulting in a fireproof panel.

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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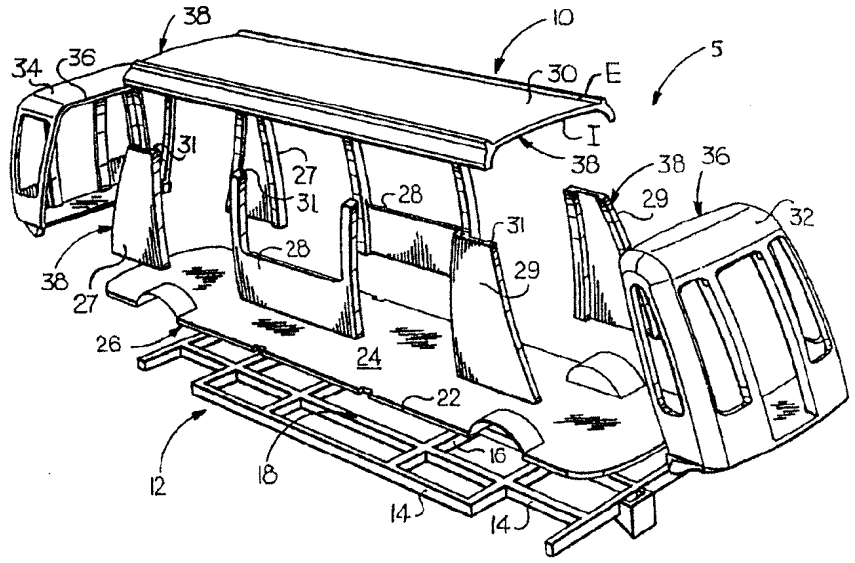
(54) **Title:** PEOPLE MOVER CARSHELLS



(57) **Abstract**

People mover carshells (10), which include a plurality of body panels which are secured to each other through an adhesive. Mechanical fasteners may also be used to prevent peeling of the body panels. The panels are formed from a composite that includes an instumescent fabric layer resulting in a fireproof panel.

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PEOPLE MOVER CARSHELLS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to vehicle bodyshells and, more particularly, to a method for securing a plurality of body panels to a people mover carshell frame.

2. Description of the Prior Art

In general, prior art vehicle bodyshells are formed by mechanically fastening or welding body panels to a vehicle frame to construct the bodyshell. In particular, it is known that prior art mechanical fastening and welding techniques are labor intensive and therefore expensive. Certified welders and skilled laborers are required to weld or mechanically fasten the body panels to the vehicle frame. Additionally, large fixtures are ordinarily required to keep the shape of the bodyshell during assembly. Furthermore, it is known that over time mechanical fasteners loosen which results in increased noise as the loosened body panels rattle against each other. Welded connections are also known to weaken and become brittle over time. Therefore, a need exists to provide a method for securing a plurality of body panels to a vehicle frame which eliminates extensive welding and mechanical fastening required by prior art construction methods.

It is therefore an object of the present invention to provide a bodyshell forming method which is less labor intensive than prior art techniques and eliminates the need for large fixtures to keep the shape of the bodyshell during assembly.

It is also an object of the present invention to provide a lighter bodyshell having improved noise coefficient reduction over the prior art.

SUMMARY OF THE INVENTION

The present invention is directed to a method for securing a plurality of body panels to a vehicle body frame. The panels are made of a polymeric material. Each

body panel includes at least one finished side with an insulating center section. The body panels are adhered to a vehicle body frame with an adhesive thereby forming a vehicle bodyshell. Fasteners may be used to prevent the body panels from peeling off the vehicle body frame. The present invention may in particular be used to form people mover vehicles. The present invention is also directed to a vehicle bodyshell which is lighter and has improved noise characteristics. The present invention is also a method for manufacturing a vehicle bodyshell utilizing the above panels.

The present invention is also a method for manufacturing a fireproof panel that includes an intumescent fabric layer and a gel layer which are placed in a mold with a resin passing therethrough and cured.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded top perspective view of a portion of a people mover vehicle made in accordance with the present invention;

Fig. 2 is a perspective view of a body panel of the present invention;

Fig. 3 is a partial cross sectional view of a mold for a part for a people mover made in accordance with the present invention;

Fig. 4 is a sectional elevated view of the part shown in Fig. 3 with an unactivated intumescent fabric layer;

Fig. 5 is a second elevational view of the part shown in Fig. 4 where the intumescent layer is activated; and

Fig. 6 is a partial sectional view of two portions of the people mover vehicle having the sections joined together.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows an exploded view of a portion of a people mover vehicle 5 made in accordance with the present invention. The portion of the people mover vehicle 5

generally includes a carshell 10 and a carshell frame 12. The carshell frame 12 may be mounted on wheels and typically includes a drive unit (not shown).

The carshell frame 12 is a substantially rectangular and rigid framework that includes a plurality of longitudinal members 14 secured to a plurality of cross members 16. The cross members 16 are arranged substantially perpendicular to and are integrally formed with the longitudinal members 14. Alternatively, the cross member 16 may be welded to the longitudinal members 14. The carshell frame 12 further includes a top surface 18 formed by the longitudinal members 14 and the cross members 16 for engaging the carshell 10. Preferably, the carshell frame 12 is made of metal.

The carshell 10 generally includes a floor panel 22 having a top side 24 and a bottom side 26, a plurality of side panels 27, 28 and 29, a roof panel 30 and two end sections 32 and 34. The side panels 27, 28 and 29 are located on each longitudinal side of the carshell 10. The two end sections 32 and 34 are respectively formed as a front end and a rear end of the carshell 10. Each of the body panels and sections discussed hereinabove may be made of a polymeric material such as fiber reinforced plastic (FRP) and a balsa core and is formed through the Seemann Composite Resin and Fusion Molding Process, as disclosed in U.S. Patent Nos. 4,902,215 to Seemann, III; 5,052,906 to Seemann; 5,316,462 to Seemann; 5,439,635 to Seemann; 5,505,030 to Michalcewiz et al.; 5,591,291 to Blackmore; 5,601,852 to Seemann; 5,648,137 to Blackmore; 5,656,231 to Blackmore; 5,702,663 to Seemann; and 5,721,034 to Seemann, III et al., incorporated herein by reference. Each of the body panels and sections discussed hereinabove has two finished sides 35 and heat and sound insulating center section 37, as shown in Fig. 2. Fig. 2 shows the centrally located side panel 28 as an example. However, although the exterior surface E and the interior surface I of the panels may be finished, it is also preferable to have only one

surface finished, preferably an exterior surface E as opposed to an interior surface I.

The carshell 10 is formed by adhesively securing the side panels 27, 28 and 29 located on each longitudinal side of the carshell 10 to the top side 24 of the floor panel 22 and adhesively securing the roof panel 30 to a top edge 31 of the side panels 27, 28 and 29. The end sections 32 and 34 are each adhesively secured along a first circumferential edge 36 to a second circumferential edge 38 formed by the roof panel 30 and the side panels 27 and 29 at each longitudinal end of the carshell 10. Preferably, the various body panels and end sections are adhesively joined together with 3M epoxy adhesive 9323BA or a methyl acrylate adhesive such as PLEXUS MA425.

The carshell 10 is then adhesively bonded to the carshell frame 12 to form the people mover vehicle 5. Preferably, the carshell 10 is adhesively bonded to the carshell frame 12 with the same adhesive disclosed hereinabove. The bottom side 26 of the floor panel 22 is adhesively secured to the top surface 18 of the carshell frame 12, again preferably with the same adhesive disclosed hereinabove. Mechanical fasteners may be provided connecting the carshell 10 to the carshell frame 12 to prevent the floor panel 22 from peeling off the carshell frame 12. Mechanical fasteners may also be provided between the various side panels 27, 28 and 29, roof panel 30 and end sections 32 and 34 at the joints therebetween to prevent the body panels and end sections from separating from one another. However, far fewer mechanical fasteners will be required under the joining process disclosed hereinabove due to the adhesive bonding at the joints of the various body panels and end sections. Additionally, reinforcement sections, such as butt-straps, adhesively bonded over the various joints are no longer required under the joining process disclosed hereinabove.

Therefore, the present invention provides a bodyshell which uses adhesive bonding at the joints between

body panels as the mechanism to transfer the bodyshell loading. The adhesive joints will be the main load transfer path of the bodyshell. Reinforcing mechanical fasteners may be used at the joints between body panels to prevent the body panels from separating at the joints. It should be understood that this invention is not limited to people mover vehicles but can also be used in any type of vehicle bodyshells such as cars, passenger trains and aircraft, as examples.

A further advantage of the present invention is that the present invention permits the carshell frame 10 to be modular. Specifically, different designs of end sections 32 and 34 can be provided to change the overall appearance of the carshell frame 12. Similarly, different design side panels 27, 28 and 29 can be provided. One need only adhesive to join the end sections 32 and 33 and side panels 27, 28 and 29 together. This modular arrangement permits the ability to easily change the appearance of a carshell 10.

As previously stated, the preferred method for manufacturing the modular components is through the SCRIMP method. The SCRIMP method used to form the composite materials includes a mold onto which a gel-coat is applied. The gel-coat includes a resinous material and pigment, such as a vinyl ester resin containing a pigment. Gel-coats are know in the art. One manufacture of gel-coats is Cook Composites and Polymers, P.O. Box 419389, Kansas City, Missouri 64141-6389, USA. A carbon impregnated fireproof or fire resistent cloth, which is an intumescent fabric, is then placed on the gel-coat film. Intumescent fabrics are known, such as described in U.S. Patent No. 4,996,099, which is hereby incorporated by reference. Next, several fiber woven layers are placed on the intumescent fabric. Next, a balsa wood core is placed on the intumescent fabric. Finally, several more layers of fiber fabric are placed on top of the core. An appropriate fluid impervious outer sheet resin distribution system and a peel ply are

applied to the system. A vacuum is drawn while resin is supplied to the resin distribution system until resin passes through the fabric layers, the core and the intumescent fabric. Once cured, the part is removed.

Specifically, Fig. 3 shows a mold that is utilized in the SCRIMP process and is similar to that described in U.S. Patent No. 4,902,215, which is hereby incorporated by reference. The mold includes a fluid impervious outer sheet 100 which is marginally sealed by tape 102 upon a rigid mold segment 104. A resin inlet 106 is defined on the outer sheet 100. A fluid distribution passageway, defined in a distribution medium 108, is defined under the outer sheet 100. A vacuum outlet 110 is defined in the rigid mold segment 104. A gel-coat layer 120 is placed in the rigid mold segment 104. An intumescent fabric layer or sheet 130 is placed on the gel-coat layer 120. The intumescent fabric layer includes an intumescent fabric such as TECHNOFIRE 60851 manufactured by Technical Fibre Products LTD, whose address is Ridgebury Park Office, 2927 Route 6, Slate Hill, NY 10973, USA. This intumescent fabric is a non-woven fabric that is porous and permits resin to flow therethrough. Alternatively, the fabric can be woven provided that it is porous and permits resin to flow therethrough. Optionally, one or more layers of fabric or sheet, such as fiberglass 140 or polymeric fiber material or felt, are placed on the fabric layer 130. A balsa wood core or structural core 150 is then placed on the fabric 140. The balsa wood core 150 includes passageways therethrough for the resin to pass. Several more layers of fabric or sheet 160, such as fiberglass or polymeric fiber material or felt, are placed on the core 150. A peel ply 170 is placed between the upper fabric layer 160 and a distribution media or arrangement 180.

In operation, a vacuum is drawn via the outlet 110 and resin is supplied via the resin inlet 106. Resin, such as a vinyl ester, passes through the distribution media arrangement 100 and the peel ply 170 and through

fabric layers 160, core 150, fabric layers 140 and fabric by 130, thereby impregnating layers 160, core 150, layers 140 and fabric 130. The structure is then cured and the part 190 removed as shown in Fig. 4. The part 190 can be any of the car body parts previously described.

The method for manufacturing the part 190, which is a fireproof panel, includes the steps of providing a rigid mold or rigid mold segment 104, placing a gel-coat layer 120 in the rigid mold by; placing an intumescent fabric layer 130 or the gel-coat layer 120; applying a liquid impervious upper layer 100 above the intumescent fabric layer 130; passing resin through the liquid impervious upper layer and through the intumescent fabric layer 130 while drawing a vacuum; and curing the resin impregnated intumescent fabric layer resulting in a fireproof part or panel 190 having a gel-coat layer 120 exterior finished surface E. One or more fiberglass fabric layers 140 and 160 and a core 150 can also be provided on top of the intumescent fabric layer 130 and below the liquid impervious layer 120, prior to providing resin to the system.

The exterior finish E is formed to be extremely glossy due to the gel-coat resin 120 and the intumescent fabric 130. In this arrangement, the exterior surface E does not need to have a separate coat of paint applied after the part 190 is formed. In some cases, the part 190 may not need a core 150 or all of the layers of fiberglass 140 and 160 as shown. The part 190 as formed has a thickness of X, however after heat is applied to the part 190 and the temperature of the fabric 130 reaches an activation temperature, the fabric 130 will expand and provide thermal and fireproof insulation and the part thickness will be X'. In other words, the part or panel 190 will have a first thickness X when the part 190 is at a first temperature or less and the part or panel will have a second thickness X' at a temperature greater than the first temperature. It has been found that use of the

intumescent fabric 130 will result in a thinner fireproof part. The prior art uses rock wool as a fireproof insulator, which results in a very thick part. For example, a prior art rock wool floor panel is four inches thick, while the use of the intumescent fabric results in a one-inch thick part having the same strength and fireproof qualities. This thinner floor panel permits for a roomier interior.

As stated previously, adjacent parts 190 and the frame 12 or other parts 190 can be secured to each other using a methyl-acrylate adhesive 192. However, to eliminate peeling of the parts, mechanical fasteners may be used. Referring to Fig. 6, a part 190, which shows a general cross-section, without showing the specific layers, is secured to the frame 12 through a methyl-acrylate adhesive 192. Spacers 194, such as washers, are provided to space part 190 to frame 12 and adjacent parts 190 (not shown). Threaded fastener 196 passes through the part 190 and the adjacent frame 12 and is received by a nut 198. The spacers 194 provide a space for the adhesive to be received. Only a few fasteners are required to prevent peeling of the part 190 from the frame 12, since the adhesive provides sufficient strength against shear and tensile forces. Hence, mechanical fasteners can be used to attach adjacent parts 190 and/or a part 190 to the frame 12 to prevent peeling of the adhesively secured parts 190.

Another advantage of the present design is that peeling is minimized through the modular design, especially because of the solid floor panel 22 and roof panel 30 as opposed to longitudinally splitting the roof panel 30 and the floor panel 24 as is done in the prior art.

Consequently, although this invention has been described with reference to a preferred embodiment, obvious modifications and alterations of the invention may be made without departing from the spirit and scope of the appended claims.

I CLAIM:

1. A modular vehicle carbody comprising;

a polymeric roof panel;

a polymeric side panel adhesively secured to said roof panel; and

a polymeric floor panel adhesively secured to said side panel.

2. A modular vehicle carbody as claimed in claim 1, further comprising a carshell frame secured to said floor panel.

3. A modular vehicle carbody as claimed in claim 1, further comprising a plurality of polymeric side panels adhesively secured to said roof panel and said floor panel.

4. A modular vehicle carbody as claimed in claim 1, further comprising first end section, adhesively secured to said roof panel and said floor panel and a second end section adhesively secured to said roof panel and said floor panel.

5. A modular vehicle carbody as claimed in claim 1, wherein each of said panels comprise a resin impregnated sheet.

6. A modular vehicle as claimed in claim 5, wherein said sheet comprises an intumescent fabric.

7. A modular vehicle as claimed in claim 6, wherein said intumescent fabric further comprises graphite.

8. A modular vehicle as claimed in claim 7, wherein said sheet further comprises at least one layer made of glass or polymeric fibers.

9. A modular vehicle as claimed in claim 8, wherein said sheet comprises a structural core.

10. A modular vehicle as claimed in claim 9, wherein said core comprises wood.

11. A modular panel as claimed in claim 6, further comprising a gel-coat layer adjacent said intumescent fabric, whereby said gel-coat layer defines an exterior surface.

12. A modular vehicle car body as claimed in claim 2, further comprising mechanical fasteners attached to respective adjacent ones of said side panel, said roof panel, said floor panel, and said carshell frame to prevent peeling of the adhesively secured panels.

13. A modular vehicle carbody as claimed in claim 12, further comprising spacers positioned between respective ones of said adjacent adhesively secured panels and said carshell frame, to define a space for adhesive to be received.

14. A fireproof panel, comprising a resin impregnated intumescent sheet, whereby when said panel is at a first temperature or less, said panel has a first thickness and when said panel is at a temperature greater than the first temperature, the panel is at a second thickness.

15. A fireproof panel as claimed in claim 14, further comprising one or more layers of glass or polymeric fiber material.

16. A fireproof panel as claimed in claim 15, further comprising a gel-coat layer adjacent said intumescent sheet that defines an exterior surface.

17. A fireproof panel as claimed in claim 15, further comprising a structural core.

18. A method for manufacturing a fireproof panel comprising the steps of:

providing a rigid mold;

placing a gel-coat layer in said rigid mold;

placing an intumescent fabric layer on the gel-coat layer;

applying a liquid impervious upper layer above the intumescent fabric layer;

passing resin through the liquid impervious upper layer and through the intumescent fabric layer while drawing a vacuum;

curing the resin impregnated intumescent fabric layer resulting in a fireproof panel having a gel-coat exterior finished surface.

19. A method for manufacturing a fireproof panel as claimed in claim 18, further comprising the steps of providing one or more fabric layers adjacent said intumescent fabric prior to passing resin therethrough.

20. A method for manufacturing a vehicle carbody comprising the steps of:

providing two members where at least one of said members is a polymeric panel;

placing a spacer between said members;

placing adhesive between the members when said spacer is located; and

securing said members with a mechanical fastener, whereby the fastener prevents peeling of said members.

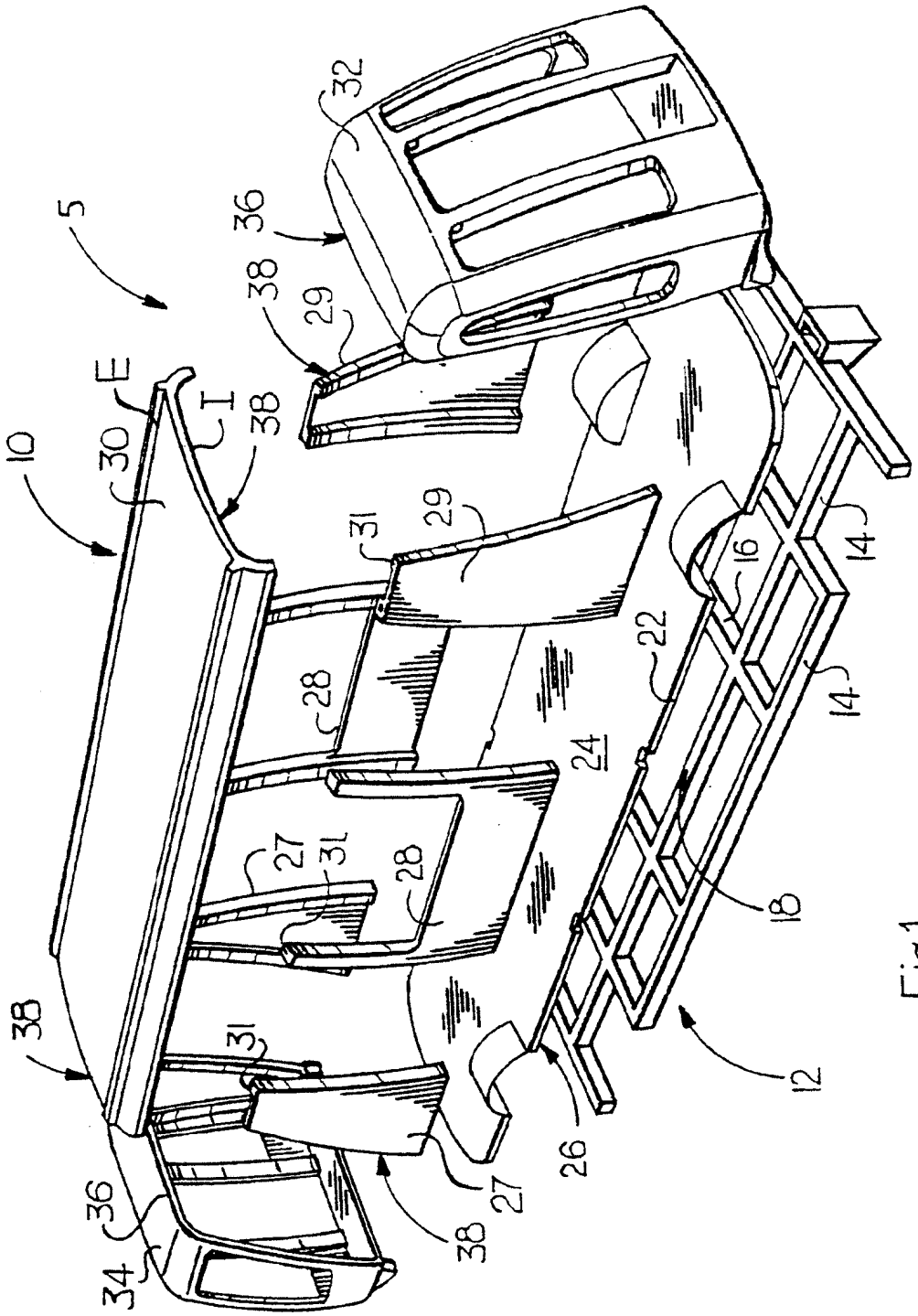

Fig.1

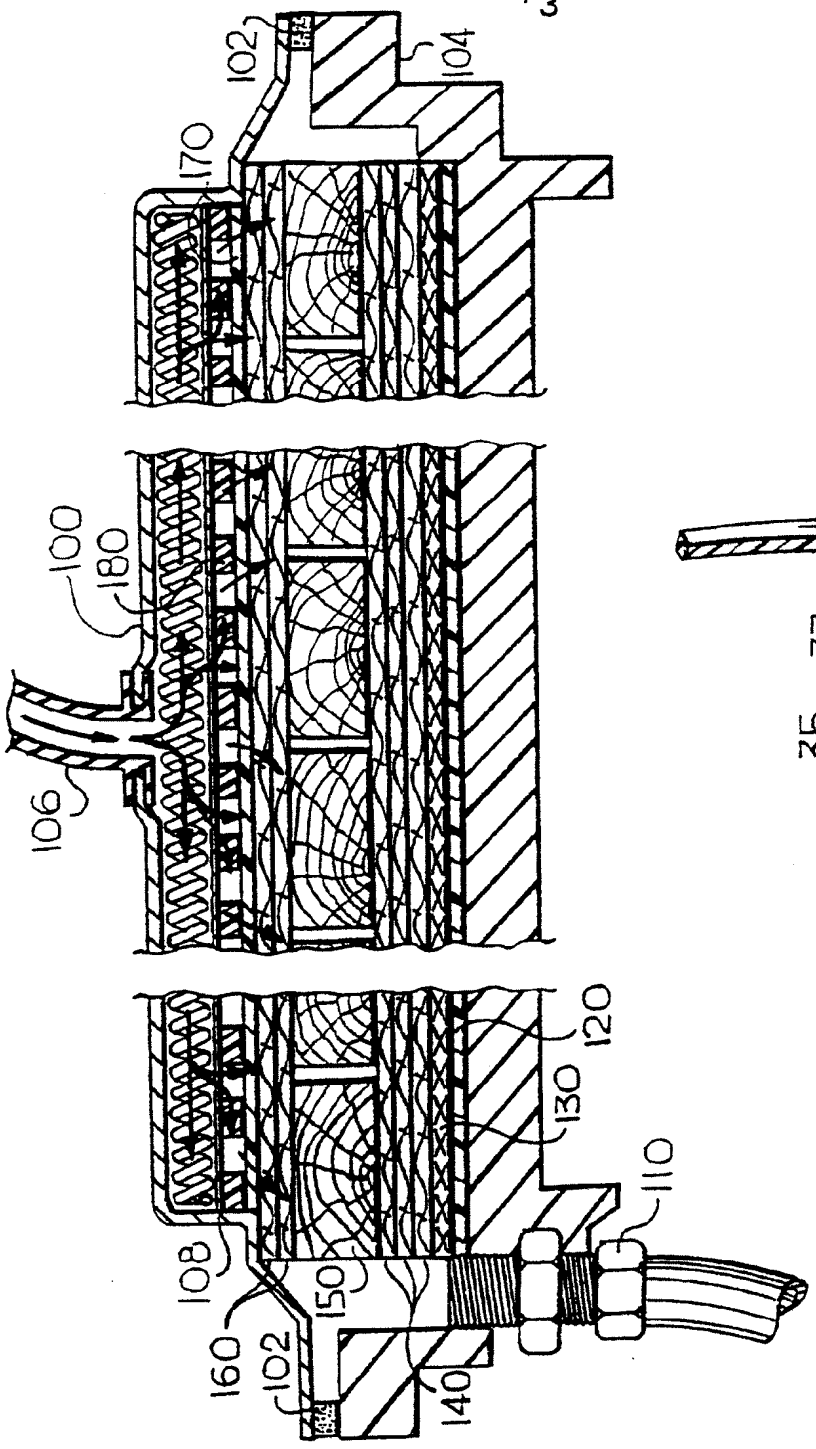
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Fig. 3

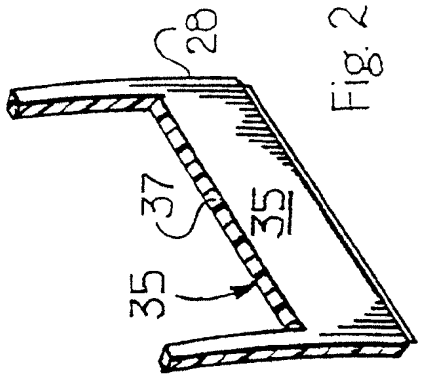
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Fig. 2

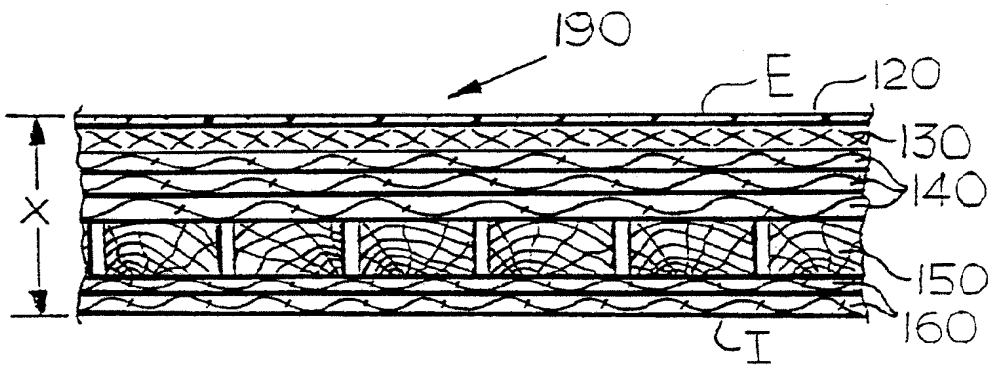

Fig. 4

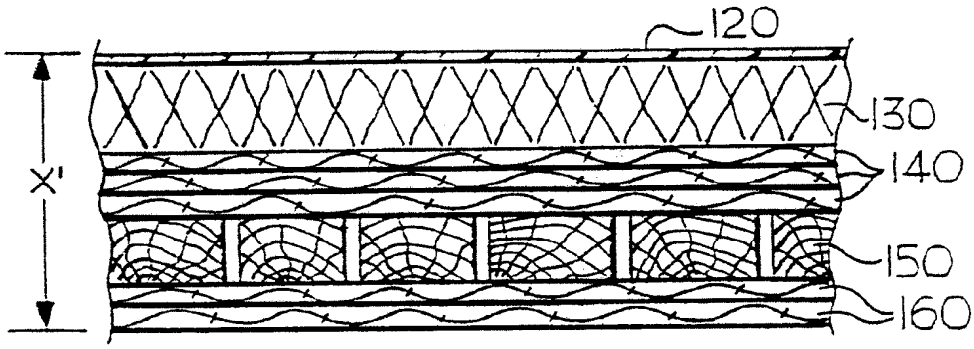

Fig. 5

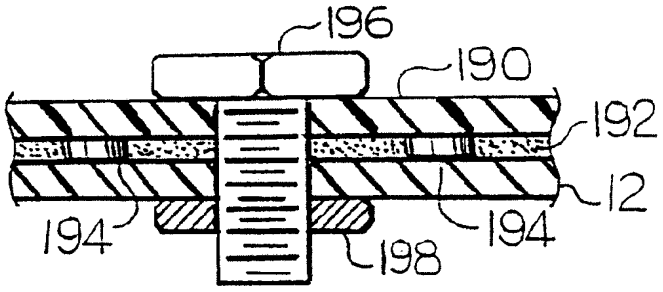

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18163

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :Please See Extra Sheet.
US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,663,920 A (Skovhoj) 12 May 1987 (12.05.87), see entire document.	1

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer LORI L. COLETTA Diane Smith for Telephone No. (703) 306-4614

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18163

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,949,536 A (Neufeld) 21 August 1990 (21.08.90), see entire document.	1
Y	IS 4,712,623 A (Martinez) 15 December 1987 (15.12.87), see entire document.	1, 3, 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18163

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18163

A. CLASSIFICATION OF SUBJECT MATTER:
IPC (6):

B60R 13/01, 07/00; B62D 29/00, 21/00; E04C 02/00, 02/32;
B29C 01/26, 43/10, 47/00, 65/00; B32B 31/06, 07/04, 07/08

A. CLASSIFICATION OF SUBJECT MATTER:
US CL.

296/39.3, 185, 189, 901; 280/781, 798; 52/232, 798; 264/101, 261, 571;
156/91, 92, 92, 245, 285

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.

296/39.3, 185, 189, 901; 280/781, 798; 52/232, 798; 264/101, 261, 571;
156/91, 92, 92, 245, 285

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

The inventions listed as Groups I, II and III do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I, claim(s) 14-17, drawn to the fireproof panel.
Group II, claim(s) 18 and 19, drawn to the manufacturing a fireproof panel.
Group III, claim(s) 20, drawn to the manufacturing a vehicle carbody.